George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

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DRAFT

Project Plan

for

Propulsion Technology

ADVANCED SPACE TRANSPORTATION PROGRAM OFFICE (ASTP)

TD15

CHECK THE MASTER LIST-VERIFY THAT THIS IS THE CORRECT VERSION BEFORE USE

BASE PROPULSION TECHNOLOGY PROJECT PLAN

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LIST OF ACRONYMS

APRS	Automatic Procurement Request System
ASTP	Advanced Space Transportation Program
ATAC	Aero-Space Technology Advisory Committee
CAN	Cooperative Agreement Notice
CDR	Critical Design Review
CI	Configuration Item
CIC	Capital Investment Council
COC	Certificate of Compliance
CWC	Collaborative Work Commitments
DFRC	Dryden Flight Research Center
DOD	Department of Defense
DOE	Department of Energy
ELV	Expendable Launch Vehicle
FRR	Flight Readiness Review
FY	Fiscal Year
GPMC	Governing Program Management Council
GRC	Glenn Research Center
GSE	Ground Support Equipment
IA	Independent Assessment
IAR	Independent Annual Review
IFPM	Integrated Financial Management Planning
ISO	Industrial Safety Office
IVHM	Integrated Vehicle Health Management
JSRA	Joint Sponsored Research Agreement
KSC	Kennedy Space Center
LaRC	Langley Research Center
LH2	Liquid Hydrogen
LOX	Liquid Oxygen
MARTS	Marshall Resources Tracking System
MM	MSFC Manual
MMI	MSFC Management Instruction
MPG	Marshall Procedures and Guidelines
MSFC	Marshall Space Flight Center
MTBF	Mean-Time-Between-Failures
MTBMA	Mean-Time-Between-Maintenance-Actions
MTTR	Mean-Time-To-Repair
NAR	Non Advocate Review

NASA	National Aeronautics and Space Administration
NDE	Non-Destructive Evaluation
NEQA	NASA Engineering and Quality Audit
NHB	NASA Handbook
NPD	NASA Program Directive
NPG	NASA Procedures and Guidelines
NRA	NASA Research Announcement
OAT	Office of Aero-Space Technology
PCA	Program Commitment Agreement
PCC	Program (Project) Cost Commitment
PDR	Preliminary Design Review
PMC	Project Management Council
PMC	Polymer Matrix Composite
RFP	Request for Proposal
R&T	Research and Technology
RLV	Reusable Launch Vehicle
S&MA	Safety and Mission Assurance
SEC	Source Evaluation Committee
SSC	Stennis Space Center
STD	Space Transportation Directorate
TBD	To Be Determined
TPS	Thermal Protection System
TRL	Technology Readiness Level
UHCT	Ultra-High Temperature Ceramics
VRC	Virtual Research Center
WBS	Work Breakdown Structure
WIS	Workforce Information System

FOREWORD

This Project Plan describes the planning and objectives for the implementation of a NASA project known as the Base Propulsion Technology Project. This plan has been prepared in accordance with the *NASA Program and Project Management Processes and Requirements*, NPG 7120.5A, and is consistent with the *NASA Strategic Management Handbook* and *NASA Program/Project Management*, NPD 7120.4.

I. INTRODUCTION

The U.S. space program is facing a growing challenge to its decades-long, global leadership position, as current launch costs consume valuable resources and limit achievements in science, exploration, and commercial development. To enable NASA to conduct better, faster, and cheaper projects, and to enable the U.S. commercial sector to flourish in space endeavors, significant reductions in the cost of space transportation must be achieved. As a result, the primary, overarching, continuing goal of NASA's space transportation technology program, derived from National Space Policy and the NASA Strategic plan, is to significantly reduce the cost of space transportation systems while improving reliability, operability, responsiveness, and safety. NASA endorses dramatic improvements in safety first, leading to lower cost and higher operability.

The Advanced Space Transportation Program (ASTP) will pioneer the identification, development, verification, transfer, and application of high-payoff space transportation technologies. The ASTP role is to develop, mature and test the technologies needed to meet NASA's unique mission requirements, as well as reduce space transportation costs to enable the commercial development of space. The ASTP will develop and demonstrate technologies up through Technology Readiness Levels (TRL) 6. These efforts will range from the observation and reporting of basic technology principles to the demonstration of system or subsystem models or prototypes in a relevant environment on the ground. Technology validation in relevant flight environments (TRL 6-7), if necessary, will be accomplished through flight demonstrations. The Advanced Space Transportation Base R&T Program Plan is the controlling document for program content and organization. The Base Propulsion Technology Project Plan will define the base propulsion activities that will be pursued under ASTP. These activities will focus on third generation and high-risk second generation reusable launch vehicle propulsion technologies.

This Base Propulsion Technology Project Plan provides an authoritative, top-level management description of the project, and is the controlling document for project content and organization. This plan is responsive to the requirements of the NASA Program and Program Management Processes and Requirements (NPG 7120.5A), but has been tailored to meet the needs of the Aero-Space Base R&T program management. The primary purpose of the plan is to establish the following:

- Project objectives and performance goals;
- Project requirements;
- Management and implementing organizations responsible for the project; and
- Project resources, schedules, and controls.

This plan will be updated annually to reflect project progress and strategic redirection.

II. OBJECTIVES

The primary ASTP objective is to mature those propulsion technologies which will provide the greatest total safety improvement and cost savings over the life of a space transportation system or the life of approved/funded missions which would utilize that transportation system.

This plan focuses on the propulsion activities associated with the third generation and high risk second generation technologies that will enable U.S. industry to reduce costs by two orders of magnitude ($100 per pound) within 25 years. The major emphasis will be on airbreathing related propulsion technologies for medium class vehicles (25,000 to 40,000 lbs. payload to low-earth-orbit). The Base Propulsion Technology Project is divided into two major subprojects:

- Propulsion Technology & Integration
- Propulsion Research & Technologies

The technology challenges to meeting these goals with related technology objectives are shown in Figure 1.

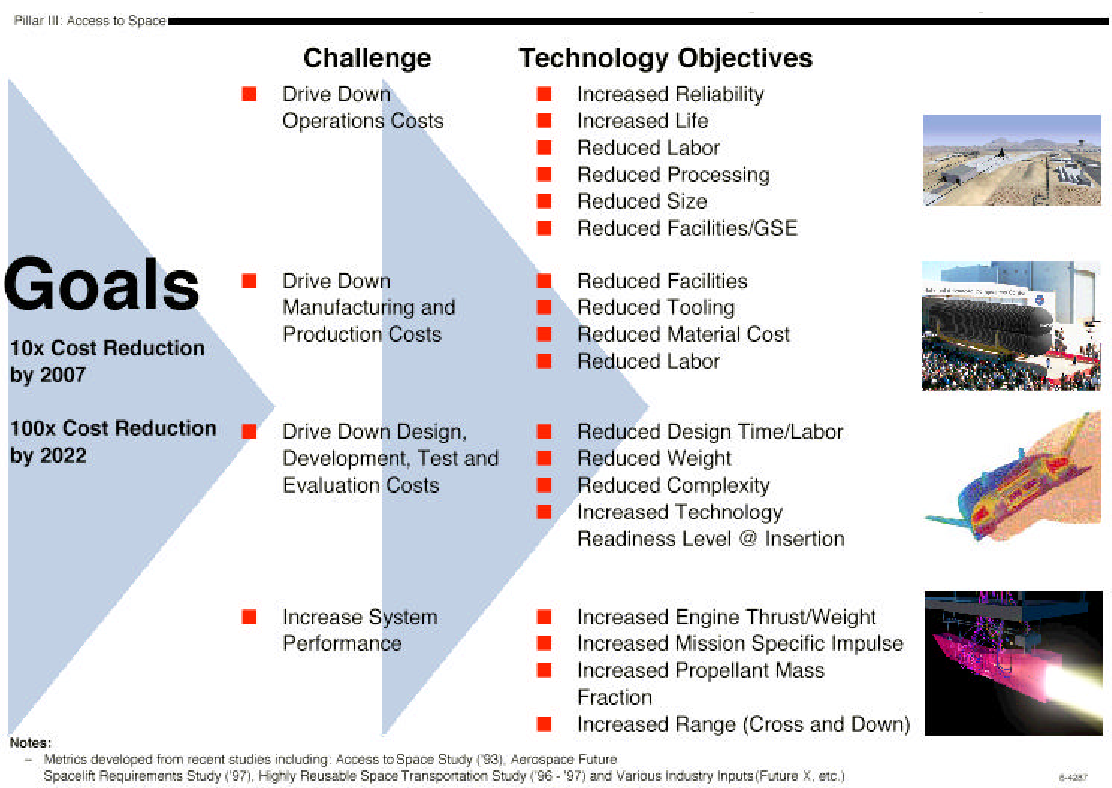

Figure 1. Challenges to Meeting Earth-to-Orbit Goals

III. CUSTOMER DEFINITION AND ADVOCACY

The primary customer for the Base Propulsion Technology Project is NASA's Office of Aero-Space Technology. ASTP is interested in the development and test of technologies that will potentially provide low-cost space transfer, have low development costs, and that will show near-term results. The Base Propulsion Technology customer base will be all inclusive of those taking advantage of the technologies developed. They include:

- Universities/Academia
- Office of Aero-Space Technology (OAT)
- Department of Defense (DOD)
- Industry

IV. PROJECT AUTHORITY

The *NASA Strategic Plan* and the *NASA Strategic Management Handbook* assign to MSFC the Lead Center responsibility for Space Transportation Systems development. This assignment includes Lead Center responsibility for the Advanced Space Transportation Program of which the Base Propulsion Technology Project is a part. The Base Propulsion Technology Project Office is responsible for project implementation and management. The Base Propulsion Technology Project Office has direct commitments with MSFC and other NASA centers through the prime contractors or between the Project Office and NASA Centers. The MSFC Program Management Council (PMC) is responsible for oversight of the Base Propulsion Technology Project.

V. MANAGEMENT

A. Organization and Responsibilities

1. NASA Headquarters

The Office of Aero-Space Technology (Code R) is the NASA Headquarters office responsible for the Base Propulsion Technology Project.

2. Field Centers

The field centers involved in the Base Propulsion Technology Project include: Marshall Space Flight Center, Glenn Research Center, Langley Research Center, Stennis Space Center, Dryden Flight Research Center, and the Kennedy Space Center. The involvement of each center is described below:

a. Marshall Space Flight Center (MSFC)

The MSFC, as the lead center for Space Transportation Systems Development and the Center of Excellence for Space Propulsion, is the principal NASA Center for research, technology maturation, design, development, and integration of space transportation and propulsion systems, including both reusable and expendable launch vehicles, and vehicles for orbital transfer and deep space missions.

MSFC is the Lead Center for the ASTP and is responsible for project implementation and management. Responsibilities are consistent with the NASA Strategic Management Handbook. The ASTP requires significant cooperation with other NASA Centers to successfully execute the project. The roles of the supporting centers are consistent with mission areas, centers of excellence assignments, and other unique center capabilities.

For the Base Propulsion Technology Project, MSFC is responsible for overall project management, RBCC propulsion technology, and cross-cutting propulsion technologies. The organizational relationships are shown in Figure 2.

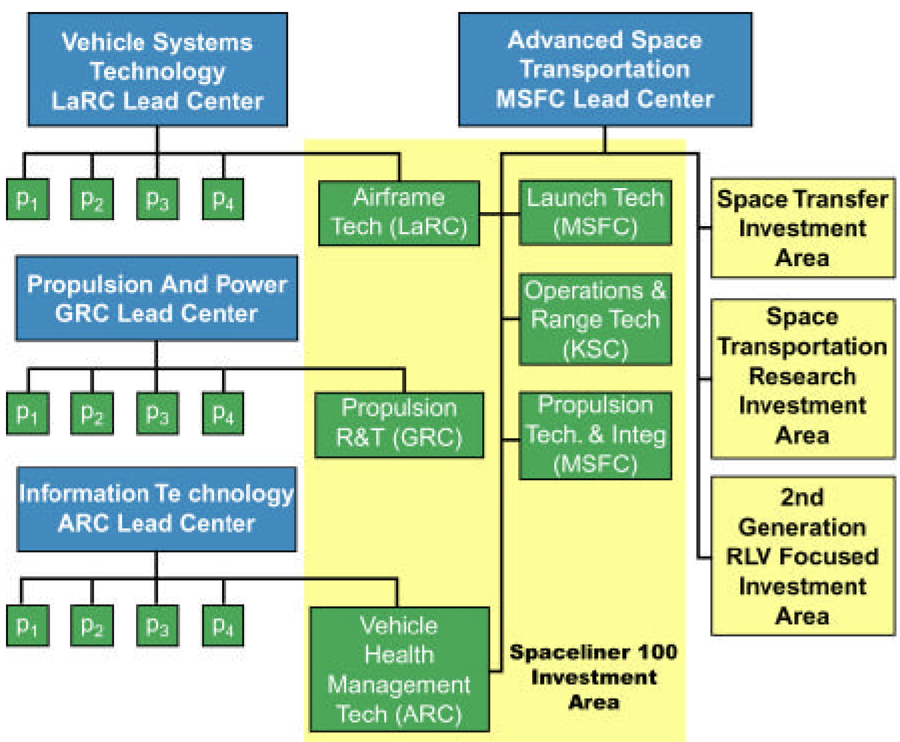

Figure 2. Relationship between the Base R&T Programs and the Base Propulsion Technology Project.

b. Langley Research Center (LaRC)
Langley is responsible for aerodynamics and aerothermodynamics testing and analysis, launch vehicle systems analysis, and hypersonic air-breathing (scramjet) flow path.

c. Stennis Space Center (SSC)
Stennis is responsible for rocket propulsion system and subsystem testing.

d. Glenn Research Center (GRC)
Glenn is responsible for aeropropulsion turbomachinery technology, high temperature propulsion materials, and combined cycle RBCC flowpath definition.

e. Kennedy Space Center (KSC)
Kennedy is responsible for ground operations technologies.

f. Dryden Flight Research Center (DFRC)
Dryden is responsible for flight testing and operations.

B. Special Boards and Committees

None.

C. Management Support Systems

The following management systems will be utilized with the Base Propulsion Technology Project. In addition, other systems within the agency are being reviewed and considered as potentials.

1. Marshall Resources Tracking System (MARTS)
The MARTS system for tracking funding authority, commitments, obligations, cost and disbursements will be utilized by the Base Propulsion Technology Project.

2. Workforce Information System (WIS)
The WIS system will be utilized for tracking the civil service workforce associated with the Base Propulsion Technology Project.

3. Automated Procurement Request System (APRS)
The S&E APRS system will be used for the Procurement Requests (Form 424) process.

4. Virtual Research Center (VRC)
The VRC is an Internet-based project management and document management system that allows all project team members access to project documents, drawings, meeting notes, assigned action items and the group calendar.

5. Other Management Systems

Current plans call for the implementation by June 1, 2000 of the Integrated Financial Management Planning (IFMP) system. This is a mandatory, agency wide tool for budgeting, tracking and analyzing funding.

VI. TECHNICAL SUMMARY

The Base Propulsion Technology Project supports the OAT Enterprise goal of conducting critical research and technology development which will enable reduction in launch costs by an additional order of magnitude ($100's per pound) within 25 years. The propulsion projects provide the base from which the technology pipeline will be filled with new propulsion developments over the next decade.

Propulsion tasks focus on the objectives of reducing operations, manufacturing, and development costs and enhancing performance margin. The approaches to meeting these objectives include:

- Improved propulsion performance to Isp > 500 sec using combined air-breathing rocket propulsion and launch assist
- Increased all propulsion system thrust-to-weight ratio through the use of metal matrix composites, ceramics, and other advanced materials
- Increased propulsion life cycle capability to 500 missions through advanced design and materials
- Improve turnaround time to 8 hrs. through automated health management and long service life

The Base Propulsion Technology Project is subdivided into the Propulsion Technology & Integration Project and the Propulsion Research & Technology Project.

A. Propulsion Technology & Integration

Propulsion Technology and Integration activities will include system engineering and integration, tool development, and cross cutting propulsion technologies. The activity is subdivided into crosscutting propulsion and hypersonic research.

1. Crosscutting Propulsion

The main focus will be on those airbreathing and rocket propulsion technologies that have the capability of being applicable to both horizontal and vertical launch vehicles, both single-stage and two-stage to orbit concepts. Focus will be on combined-cyle airbreathing propulsion systems, rocket thrusters and pulse detonation rocket engines. Additionally, this activity will include the ancillary system component technologies (e.g., turbomachinery, pumps, valves, controllers, actuators, etc.) that will be required to support any propulsion system.

2. Aerodynamic and Scramjet Research

The main focus will be on those propulsion technologies that are applicable to airbreathing engine designs for propulsion systems that have the capability of operating at very high speeds (Mach number >12).

B. Propulsion Research & Technology Project

These activities will focus on airbreathing propulsion flowpath concepts for rocket-based combined cycle propulsion. The activities will also include turbine-based technology development. Testing will focus on propulsion materials research and flowpath development.

VII. SCHEDULES

Current project milestones include:

- Flowpath Definition and Testing Completed for 1st Flight Demonstrator in 4QFY01*
- Select Engine Systems for 1st Demonstrator Application in 4QFY01*
- First Flight Test of X-43 in 3QFY00
- Complete 1st Demo Vehicle Preliminary Design in 1QFY01
- Second Flight Test of X-43 in 1QFY01
- Third Flight Test of X-43 in 4QFY01
- Complete 1st Demo Vehicle Structural Design in 1QFY02
- Submit Pathfinder Proposal for 1st Flight Demonstrator in FY02
- Complete Rocketdyne & Aerojet Flowpath Testing by end of FY01
- Complete GRC "Trailblazer" Flowpath testing in FY03
- Complete GRC "Trailblazer" Demo Vehicle Preliminary Design in FY04
- Submit Pathfinder Proposal for 2nd Flight Demonstrator in FY05
- First Flight Test of GRC "Trailblazer" Engine in FY07
  (* ASTP Program Plan Milestones)

VIII. RESOURCES

Funding for the Base Propulsion Technology Project covers all effort, materials and services. The program funding plan by fiscal year are shown below:

A. Funding Requirements (NOA in Millions)

FY00	FY01	FY02	FY03	FY04	TOTALS
29.4*	53.3	73.9	96.0	98.6	351.2

* Includes $9.5M of 523 funding

B. Institutional Requirements (FTE)

FY00	FY01	FY02	FY03	Totals
TBD	TBD	TBD	TBD	TBD

IX. CONTROLS

The Base Propulsion Technology Project is subject to the controls as contained in NASA Procedures and Guidelines, NPG 7120.5A. The ASTP Program Plan and PCA establish the top level technical, schedule, and cost controls placed on the project. A semi-annual review of this plan will be performed to accommodate the changing nature of advanced technology projects. All revisions to the Project Plan will be coordinated with the Deputy Associate Administrator for Space Transportation Technology. Responsibilities for Program and Project Management are as follows:

A. Headquarters Responsibilities

Associate Administrator for Aero-Space Technology

a. Providing program advocacy.
b. Establishing program requirements and metrics.
c. Recommending the level of GPMC oversight for each new program.
d. Assigning program and selected project responsibilities to Lead Centers.
e. Recommending new programs to the Agency PMC.
f. Developing, coordinating, and maintaining the PCA.
g. Approving Program Plans.
h. Assessing program performance against requirements and customer expectations.
i. Ensuring timely resolution of multiple program and project issues with assigned enterprise.
j. Serving as a member of the GPMC.
k. Allocating budgets to programs.

B. Center Responsibilities

1. The Lead Center Director (MSFC)

a. Serving as Chairperson of Lead Center PMC.

b. Supporting the Associate Administrator of Aeronautics and Space Transportation Technology in program formulation.
c. Providing overall direction, control, and oversight of program implementation.
d. Appointing the program manager.
e. Concurring on the Program Plan for Associate Administrator approval.
f. Assigning work to other Centers.
g. Integrating institutional resources with program needs.
h. Coordinating cross-Center activities.
i. Ensuring compliance to policy/standards.
j. Maintaining dual path for Quality and IA.
k. Developing and maintaining program/project implementation policies and procedures compliant with NPD 7120.4, NPG 7120.5A, and ISO 9000.

2. Performing Center Director (MSFC, LaRC, GRC, SSC, KSC, DFRC)

a. Performing advanced concept studies in support of Agency and Enterprise strategic plans.
b. Supporting the program formulation.
c. Approving Project Plan.
d. Appointing the Project Manager.
e. Project implementation and oversight.
f. Developing and maintaining program/project implementation policies and procedures compliant with NPD 7120.4, NPG 7120.5A, and ISO 9000.

3. ASTP Program Manager

a. Program planning, including recommendation of program objectives, requirements, implementation guidelines, program integration, budget and milestones, and preparation of Program Plans and PCAs.
b. Developing, recommending, and advocating the program resources.
c. Execution of the Program Plan and oversight.
d. Approving Project Plans and associated changes to these documents.
e. Reviewing and reporting program/project performance.
f. Establishment of project requirements and performance metrics.
g. Allocating budget to projects.
h. Control of program changes.
i. Establishing support agreements.

4. Base Propulsion Technology Project Manager

a. Preparation and maintenance of the Project Plan, specifications, schedules, and budgets.

b. Acquisition and utilization of participating contractors.
c. Execution of the Project Plan.
d. Reporting project status.
e. Approving Task Agreements.
f. Conducting design and all other appropriate reviews.
g. Participation in Configuration Control Board Activity.

C. Interface Controls

The Level II Board chaired by the STD Director controls interfaces among Centers and among the several STD programs. Interfaces between the ASTP program elements are controlled by the ASTP Program Manager.

D. Design Controls

Design controls will be established for each ASTP project in accordance with NASA procedures and documented in project plans. The level of design control will be determined on a case-by-case basis for each project.

X. IMPLEMENTATION APPROACH

A. Implementation Plan

The ASTP acquisition strategy is based on both NASA in-house and contracted activities. Because of the experimental nature of the ASTP and tight time schedules, every emphasis will be placed on short procurement approaches. Existing contracts, NASA Research Announcements, Cooperative Agreements, Space Act Agreements, purchase orders, and support agreements will be utilized to the greatest extent possible.

Descope Options

Descope options at the project level will be identified by the Propulsion Base R&T Project Office and presented when necessary to the Lead Center Project Management Council (PMC). Any requests for descope options subsequent to the approval of the project plan that involve impacts to near-term project milestones or reductions in resource allotments to supporting centers will be coordinated with the supporting centers. Any descope options or proposals that are made as part of the annual update to the project plan will be explained to the Aero-Space Technology Executive Board prior to request for signing of the plan.

Descope options must consider the differences in approach that are dependent on the organizations involved. Partnerships with industry and/or other Agencies will involve the management of those organizations up to and including the signatories of the original agreement. The possibilities also include near-term (within the current year, but subsequent to the signed project plan) and longer-term.

If out-year budget restrictions were to necessitate major reductions in the ASTP, the first options considered would be limitation or elimination of some of the planned projects. Priorities established during the technology assessment process in Section XVIII would be used to decide which activities would be limited or eliminated. Major curtailment or elimination of investments in specific technology areas may accommodate more severe reduction requirements, also in accordance with priorities established during the technology assessment process.

B. Project Summary WBS

TBD

XI. ACQUISITION SUMMARY

Due to the broad nature of the Advanced Space Transportation Base R&T project, a variety of acquisition instruments will be employed. Procurements will be in accordance with approved procedures at the procuring Centers. Free and open competitive procurements will be used to the maximum extent possible. Among the approaches to procurement, the most likely include NASA Research Announcements (NRA), NASA Cooperative Agreement Notices (CAN), and Requests for Proposal (RFP). These vehicles will result in grants, cooperative agreements and contracts. For any onsite contractors, performance based contracts are the preferred instrument.

The special cases where the procurement is for a major activity within the project should be described. As an example (with comments), consider this one from the Flight Research acquisition strategy: For the special case of the ERAST Alliance, a Joint Sponsored Research Agreement (JSRA) was established. On one other project, the Autonomous Formation Flight, the JSRA instrument was used because of the unique situation that both private industry (Boeing) and a university (UCLA) wished to contribute corporate resources, together with the NASA funding. The JSRA was the only mechanism available for this unique combination.

Multiple procurements are anticipated annually. Most procurements will use the competitive NRA process. Solicitations for multiple elements of the Project will be combined within one NRA where appropriate. The acquisition process will allow for government-only, industry/university-only, and government-industry/university teams to bid for ASTP technology tasks. It is anticipated that there will be multiple awards. Cost-sharing will be encouraged, but will not be required for selection. Innovative means of data sharing will be encouraged in order to assure the fastest possible transition of technology to the end users.

Proposals will be evaluated against the following factors:

- Relevance to NASA's Objectives
- Traceability of the technology to a next generation concept(s)
- Synergism with a broad range of space transportation system needs
- System payoff to an operational space transportation system.

Specific areas of evaluation include:

Operations Cost Drivers:

Increase reliability/life - How do the technologies increase the reliability/life of the system? Examples of ways the reliability/life of the system can be improved include but are not limited to: increasing the mean-time-between failure (MTBF) of critical components, by reducing the number of failure modes of critical integrated systems, by reducing the consequences of failure modes of critical integrated systems, etc. Examples of ways in which this can be accomplished include but are not limited to: improving system margins, increasing number of fill/drain mission cycles for a cryogenic propellant tank system, eliminating the interpropellant seal in an engine, etc.

Reduce processing time/labor - How do the technologies reduce the processing time and labor required between missions? Examples of ways processing time and labor can be reduced include but are not limited to improvements in mean-time-between-maintenance-actions (MTBMA) and mean-time-to-repair (MTTR) of components and integrated systems and decreasing the operational complexity of the system. Examples of factors that affect the operational complexity include but are not limited to: number of parts, number of possible leakage sources, number and amount of toxic fluids, number of purges required, etc. Examples of ways in which this can be accomplished include but are not limited to: automating time- and labor-intensive procedures through the use of integrated vehicle health management (IVHM) systems, etc.

Reduce system size/gross weight - How do the technologies reduce the overall dimensions and total gross weight of the system? Reducing the size and gross weight of launch vehicles while retaining or improving operability will contribute to reduced launch costs through simplified handling and logistics, reduced propellants, and smaller launch infrastructure. Example of ways in which this can be accomplished, but are not limited to: very light weight structures, propellant tanks and propulsion systems, increased propulsion system specific impulse, densified propellants, etc.

Reduce facilities/GSE required - How do technologies reduce the amount of facilities and ground support equipment (GSE) required by the system? A number of unique facilities are required to operate, process and launch space systems. Launch and landing facilities/GSE include but are not limited to: launch processing hardware and software, flame trench, umbilicals, release mechanisms, acoustic suppression systems, launch tower, structural supports, passenger loading system, propellant loading/storage system, landing strip, safing system, etc. Processing facilities /GSE include but are not limited to: vehicle processing shelters, payload loading/processing shelters, scaffolding, cranes, test and checkout hardware and software, diagnostic tools/equipment, servicing tools/equipment, non-destructive evaluation (NDE) tools/equipment, TPS waterproofing systems, purge systems, etc. Mission operations facilities/equipment include but are not limited to control center, computers/software, communications equipment, tracking systems, etc.

Manufacturing / Production Cost Drivers:

Reduce tooling/materials required: - How do the technologies reduce the amount and complexity of tooling/materials required for manufacturing and producing the system? Examples of factors that affect the amount and complexity of tooling/materials required for manufacturing and producing the system include but are not limited to: number and size of parts to be integrated, type of material, curing requirements, fiber lay-up requirements, stiffening requirements, number and complexity of joints, number and complexity of interfaces, engine inlet pressure and temperature requirements, complexity of external/internal geometry, amount of existing tooling used, etc.

Reduce manufacturing/production time/labor: - How do the technologies reduce the processing time and labor required to manufacture and produce the system? Examples of ways in which the manufacturing/production time/labor can be reduced include but are not limited to: automating time- and labor-intensive procedures, reducing the number of parts and systems to be integrated, simplifying interfaces, reducing the number of welds and joints, maximizing use of existing procedures, etc.

DDT&E Cost Drivers:

Reduce vehicle empty weight: - How do the technologies reduce the empty weight of the flight vehicle? Examples of ways in which the empty weight of the system include but are not limited to: reducing by directly reducing the weight of heavy components, directly reducing the weight of interfaces (joints, welds, bonds, fasteners, etc.), increasing the engine thrust-to-weight ratio, increasing the engine specific impulse, etc.

Reduce system complexity: - How do the technologies reduce the complexity of the system to be developed? Examples of factors that affect the development complexity of the system include but are not limited to: total number of parts, number of components and systems to be integrated, degree of complexity/coupling of interfaces, amount of performance margin available, complexity of internal/external geometry, level of propulsion/airframe interaction, etc.

Mission Performance Considerations:

Improve mission performance: - How do the technologies improve key mission performance characteristics of the system? The ability of the system to achieve its intended mission can be enhanced by technologies that improve mission performance. Examples of ways in which technologies can improve mission performance include but are not limited to improving vehicle L/D, improving vehicle stability/control, improving TPS/structure temperature capability, etc.

Intrinsic Merit of the Proposal

- Overall scientific or technical merit of the proposal or unique and innovative methods, approaches, or concepts demonstrated by the proposal
- Offeror's capabilities, related experience, facilities, techniques, or unique combinations of these which are integral factors for achieving the proposal objectives
- The qualifications, capabilities, and experience of the proposed principal investigator, team leader, or key personnel critical in achieving the proposal objectives
- Overall standing among similar proposals and/or evaluation against the state-of-the-art
- Reasonableness and Realism of Cost (including cost-sharing)

The MSFC Center Director will establish the Source Selection Official. The Source Selection Official will establish the Source Evaluation Committee (SEC) chairman. The SEC will consist of members from the appropriate NASA supporting centers and other agencies.

XII. PROGRAM/PROJECT DEPENDENCIES

TBD

XIII. AGREEMENTS

A. Internal NASA Agreements

Task agreements, MOUs or other formal documentation will be established between the Project Office and other participating Centers.

B. External Agreements

MSFC will establish external agreements through prime contractors, small businesses, industrial vendors, universities and other agencies. The ASTP will leverage expertise and technology development efforts within other national projects to most effectively develop high risk technologies.

C. NASA/DoD Agreements

NASA has been assigned the Lead Agency for the development of Reusable Space Transportation systems, most of which have applicability for future DOD technology requirements. NASA and the Air Force have signed a Memorandum of Agreement calling for cooperative technology development and demonstration in support of NASA's Advanced Space Transportation Program and the military Space Operations Vehicle. The ASTP will pursue cooperation with the DOD Air Force Research Laboratory and the DOE laboratories, where appropriate.

XIV. PERFORMANCE ASSURANCE

Quality

A quality management plan will be prepared only for the Base Propulsion Technology Project elements that deal with flight hardware. Base Propulsion Technology flight hardware designed, developed and built in-house at MSFC will be in accordance with the MPG 144.1. In-house hardware may be built to dated drawings with the approval of the Chief Engineer and the Lab lead, as specified in the Base Propulsion Technology Configuration Control Plan. As built drawings will be submitted to the MSFC Configuration Control Process as specified in the Base Propulsion Technology Configuration Control Plan.

Due to the limited scope of the Base Propulsion Technology flight demonstration experiments, flight hardware may be commercial off-the-shelf as long as it meets the requirements specified in the Base Propulsion Technology Systems Specification.

Base Propulsion Technology flight hardware purchased from outside vendors is not required to be ISO 9000 compliant. Base Propulsion Technology flight hardware purchased from outside vendors will be based on the specific requirements of NHB 5300.4(1C). Tailoring of these requirements will be reflected in the Base Propulsion Technology Quality Plan and/or in the vendor purchase order/contract.

Base Propulsion Technology flight hardware purchased from outside vendors must be delivered with a Certificate of Compliance (COC) and an acceptance data package as specified in the purchase order or contract.

XV. RISK MANAGEMENT

A risk management plan will be prepared only for the Base Propulsion Technology Project elements that deal with flight hardware. This plan will document a continuous process that:

- identifies risks
- analyzes their impact and prioritizes them
- develops and carries out plans for risk mitigation, acceptance, or other action
- tracks risks and the implementation of mitigation plans
- supports informed, timely, and effective decisions to control risks and mitigation plans
- assures that risk information is communicated among all levels of the project

Risk management begins in the formulation phase with an initial risk identification and development of a Risk Management Plan and continues throughout the product's life cycle through the disposition and tracking of existing and new risks.

XVI. ENVIRONMENTAL IMPACT

Environmental impact assessment(s) shall be developed as needed by the appropriate center(s) Environmental Engineering and Management Office(s).

XVII. SAFETY

The Base Propulsion Technology Project will utilize existing Center safety guidelines to provide for the early identification, analysis, reduction, and/or elimination of hazards that might cause the following:

- Loss of life or injury/illness to personnel
- Damage to or loss of equipment or property (including software)
- Unexpected or collateral damage as a result of tests
- Failure of mission
- Loss of system availability
- Damage to the environment

As required for specific tasks in the Base Propulsion Technology Project a safety plan that details such activities as system safety, reliability engineering, electronic and mechanical parts reliability, quality assurance for both hardware and software, surveillance of the development processes, "closed loop" problem failure reporting and resolution, environmental design and test requirements will be developed.. Mission success criteria shall be defined to aid in early assessment of the impact of risk management trade-off decisions. The safety and mission success activity shall accomplish the following:

- Provide for formal assessment and documentation of each hazard, with risks identified, analyzed, planned, tracked, and controlled.
- Provide for a safety assessment and certification regarding readiness for flight or operations, explicitly noting any exceptions arising from safety issues and concerns.
- Utilize a quality management system governed by the ISO 9000 standard, appropriate surveillance, and NASA Engineering and Quality Audit (NEQA) techniques.

XVIII. TECHNOLOGY ASSESSMENT

Ongoing assessment of needs for technology will be conducted by project management to insure that long term goals can be met.

XIX. COMMERCIALIZATION

Many of the technologies to be demonstrated have direct commercial application.

XX. REVIEWS

A. Management Reviews

Management Reviews will be scheduled during the life of the project. The type and frequency of the reviews will be established according to the unique needs of the Project and the Program Office. The reviews will be scheduled to keep program and project management informed of the current status of existing or potential problem areas. Agency management will be informed, in advance, of the schedule and agenda of the major reviews and will be invited to participate at their discretion. Special reviews by any level of management will be conducted when the need arises.

Efficient management of the Advanced Space Transportation Base R&T project requires effective communication through reviews and reports. The following reviews have been established to communicate project progress and information to working groups, management and industry.

1. Aeronautics and Space Transportation Technology Enterprise Review

Reviews will be held with management of the Aeronautics and Space Transportation Technology Enterprise at least semi-annually to discuss progress toward accomplishment of goals for the project. Reviews of the project with outside independent groups to assess the overall progress of the project will be held and reports provided to Enterprise management.

2. Lead Center Program Management Council (PMC) Review

As a project in the Advanced Space Transportation Program, the Base Propulsion Technology Project will be reviewed during the lead Center Program Management Council Review. The reviews will cover overall status information, including schedule, change, performance, funding, interfaces coordination, and other management and technical topics. The Lead Center PMC review will also assess project progress against metrics and criteria proposed in procurement instruments.

3. Aero-Space Technology Advisory Committee (ATAC)

The ATAC reviews the Advanced Space Transportation Base R&T project through its Space Transportation Subcommittee. This review is an effective means to provide project information to the top management of U.S. industry, other government agencies and academia, in terms of status, performance, issues, budget and plans. This high level NASA/industry review is held semi-annually and serves as a two-way platform to exchange project-related ideas, issues and industry concerns and to revalidate the project.

4. Quarterly Program Review

A quarterly program review will be held to review cost, schedule, and technical issues. The location of the review will be determined on a case-by-case basis. Participants will include, as a minimum, the program managers of the ASTP and STD offices.

5. Twice Monthly Telecon

The Deputy Director, Projects Division, and OAT project managers participate in a telecon held on the second and fourth Tuesdays of each month to facilitate the day-to-day implementation of their projects. This telecon also provides an opportunity for those responsible for the implementation of OAT projects to collectively address issues and/or actions requiring immediate attention.

6. Other Reviews

Other independent reviews will be scheduled as required and will include the participation of all NASA Centers involved in the Base Propulsion Technology Project. The reviews will cover the overall status information and will include schedule status, change status, performance status, interface coordination, and other management and technical topics.

B. Technical Reviews

Technical Project Review

The Base R&T Project Office conducts an annual in-depth, inter-Center review of each project. The Center with responsibility as lead of a project is responsible for presenting the reviews to the Project Office.

XXI. TAILORING

The requirements of NASA Policy Directive (NPD) 7120.4A and NASA Procedures and Guidelines (NPG) 7120.5A apply to this program as tailored by the ASTP Program Plan.

XXII. RECORDS RETENTION

The Airframe Technology Project Manager will determine which project records will be retained and for how long in order to ensure a permanent record of the project and lessons learned are available to benefit future NASA projects. Governing documents will be kept in accordance with the required policies and procedures of the relevant Center.

XXIII. CHANGE LOG

EFF. DATE	STATUS	DOC. REVISION	DESCRIPTION
Dec 13, 1999	Baseline	-	Initial Issue